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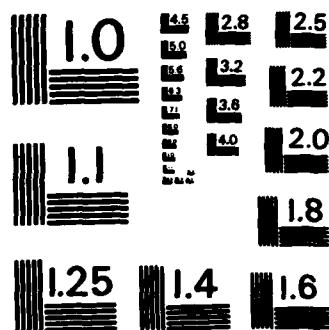
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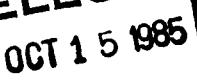
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# Numerical Analysis

Annual Report

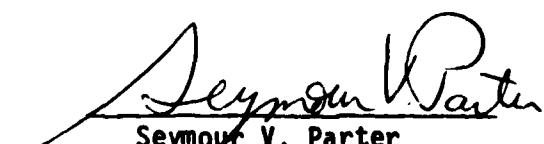
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For Period: June 15, 1984 - June 14, 1985



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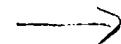
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Seymour V. Parter  
Principal Investigator

1. Goals of the Grant

→ A

The proposal to AFOSR emphasized research on iterative methods for the solution of discrete elliptic boundary-value problems. A topic of special interest is the study of multigrid iterative methods.



See AF473 (over)

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## 2. Progress to Date

I. Three reports were completed during this period. They are:

- (1.) D. Kamowitz and S. V. Parter: On MGR[v] Multigrid Methods, University of Wisconsin-Department of Computer Sciences Technical Report #575 (January 1985). Submitted to SIAM J. on Numerical Anal.
- (2.) D. Kamowitz and S. V. Parter: Multigrid and MGR[v] Methods for Diffusion Equations, University of Wisconsin-Department of Computer Sciences Technical Report #577 (February 1985). To appear: Journ. Comp. Math-Chinese.
- (3.) S.V. Parter: A Note on Convergence of the Multigrid V-Cycle. University of Wisconsin-Department of Computer Sciences Technical Report #555 (September 1984). To appear: Applied Mathematics and Computation.

The first two reports are concerned with getting "sharp" estimates for a particular multigrid iterative method, the MGR[0] methods developed by Ries, Trottenberg and Winter - and independently by Braess. There is ongoing work on this class of problems. The major point of this line of research is not only the analysis of the MGR[v] methods but the development of techniques for sharp estimates of the rate of convergence of multigrid methods. The third report deals with a general convergence result. Earlier work by Yserentant, Bank and C. C. Douglas and Braess and Hackbusch is simplified and extended to include the case of indefinite smoothers.

II. Professor Parter and David Kamowitz have participated in several meetings at which they have presented talks on this research and earlier work. In particular

- (1.) Professor Parter was an invited speaker at the DD5 Conference on Numerical Methods for Partial Differential Equations held in Beijing, China, August 1984. The report (2.) above is an extension of his remarks at that meeting.
- (2.) Professor Parter gave lectures on Multigrid at Xi'an Jiaotong in Xi'an, China and at Hunan University, in Changsha, China.
- (3.) David Kamowitz gave a presentation on the "Crystal" implementation of multigrid and other iterative methods for elliptic equations. "Crystal" is the multiprocessor (multi-Vax) project at the University of Wisconsin-Madison.
- (4.) Professor Parter gave an invited lecture at the Second SIAM Conference on Linear Algebra held in Raleigh, North Carolina, April 28-May 1, 1985. He spoke on the study of families of matrices  $\{A_n\}$  of increasing dimension as these questions arise in the analysis of numerical methods for particular differential equations.

III. Professor Parter and David Kamowitz visited the Los Alamos National Laboratory: May 20-June 14, 1985. During that time

- (1.) Parter held conversations with T. Manteuffel and V. Faber concerning the problem of estimating - independent of  $h$  - the condition number of operators of the form  $A_h B_h^{-1}$  where

$A_h, B_h$  are discrete approximations to elliptic operators.

This question arises in connection with the application of preconditioned conjugate gradient iteration methods.

- (2.) Parter had discussions with T. Manteuffel and others on the general question of "singular values" of families  $\{A_n\}$  of matrices of increasing dimension.
- (3.) Kamowitz undertook a study of the application of multigrid iterative methods for the solution of "transport problems".

Research on all of these questions is continuing.

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